

*A Letter written to the Publisher by the Learned Mr. Ray, containing some Considerations on the Conjecture in Numb. 114. of these Tracts, about the swimming Bladders in Fishes.*

*This Letter is not mentioned in the Contents, because it was thought at the time when the first sheet was a printing, the Discourse about the precedent Instrument would have taken up all the room of this Tract.*

SIR,

I was much pleased and satisfied with the ingenious conjecture I found in your *Transactions* of May last, pag. 310. concerning the swimming Bladders of Fishes; and perswade my self that the Author thereof hath hit upon their true use, viz. to sustain or keep them up in any depth of water. For 1. it hath been observed by some, and I find it in Mr. *Willughbyes* general notes of Fishes, that if the swimming bladder of any Fish be pricked or broken, such a Fish sinks presently to the bottom, and can neither support nor raise up it self in the water. 2. Flat Fishes, as *Soles*, *Plaice*, &c. which lie alwaies groveling at the bottom, have no swimming bladders that I could ever find. 3. In most Fishes there is a manifest channel leading from the gullet or upper orifice of the stomach to the said bladder, which without doubt serves for conveying air thereinto, as may easily be tried by any one that pleases. But though air may be received into the bladder, yet is there a valve or some other contrivance to hinder the egress of it; for you shall sooner break the bladder than force any air out by this channel. Yet in *Sturgeons* Mr. *Willughby* hath observed, that pressing the bladder,

Bladder, the stomach presently swelled: So that it seems in that Fish the air passes freely both wayes. Possibly, the Fish while alive may have an ability to raise up this valve, and let out air upon occasion, which yet I doubt of, because other Animals have no such faculty of opening any valves made to stop the reflux of fluids. But I verily think, there is in the coat of this bladder a musculous power to contract it when the Fish lifts: For, in many Fishes it is very thick and opaque, like the coat of an Artery ( which hath, as Dr. *Willis* observes, such a muscular faculty ) as for example in all the Cod-kind; in some, v. g. the *Hake*, called in Latin *Merlucius*, it is inwardly covered with a red carneous substance, which I take to be musculous flesh; in others, it is forked at the top, and to each horn hath a muscle affixed. Now the musculous force need not be great, being still assisted by the water as the Fish descends; the pressure of the water being much greater at the bottom than at the top, as appears by the ascending bubble. But whereas it is said, Perhaps the Fish can by its sides or some other defence keep off the pressure of the water, and give the air leave to dilate it self: It may be objected, if it can do so, what needs then any air-bladder? the cavity of the *abdomen* may serve the turn. To which I answer, that this power of dilating the *abdomen* by the muscles may assist Fishes to rise, whose natural place is toward the bottom; and the Air compressed in the bladder dilating it self as the Fish ascends, facilitates the action of the muscles. But those Fishes that descend by contracting the bladder, letting the contracting muscle cease to act, will rise again of their own accord, the Air within dilating it self, as we see in glass bubbles by compression of the Air in them descending, which as soon as the force is removed ascend without more ado. Besides the flat Fishes I before mentioned, all the cartilaginous kind, as well flat as long, want swimming bladders: What course they use to ascend and descend in the water, I know not. Many of the Eel-kind ( not all ) have swimming bladders; yet can they hardly raise themselves in the water, by reason of the length and weight of their tails: I suppose, the Air-bladder being near their heads

heads helps them to lift up their head and fore-part: Great diversity there is of swimming bladders in respect of figure, substance, situation and connexion in several Fishes: But not being able to give you any reasonable account of each, I shall forbear to add any thing further of them.

S I R,

*Your very humble Servant*

*Middleton, June  
22. 1675.*

John Ray.